

But he wisely points out that the Simplon is only one of a series of enterprises of the same kind, and while there have been improvements in the methods of working, as well as in the use of better explosives, the merit of originality belongs more properly to what is commonly known as the Mont Cenis tunnel. Tourists to whom the name Fréjus represents a town on the Riviera will be somewhat surprised to find this tunnel described as the Galleria del Fréjus, which appears to be its correct name. In addition to this, the St. Gothard, the Arlberg, and other well-known tunnels, the author describes several minor borings not commonly noticed by tourists, but which possess points of special interest; for example, one at Laveno, on Lago Maggiore. The result is a volume of 1228 pages (excluding tables), and a second volume of plates, which form a striking contrast to the small Manuli Hoepli of the same publisher. When we come to eighty pages of "Final Considerations," we cannot help being reminded of the typical interminable sermon of our early days, and the analogy is further increased by finding 115 pages of "appendix to the final considerations" to follow. But all the same, the author cannot be accused of long-windedness. There are a great many details connected with the boring of a tunnel, such as the rate of progress through different rocks, temperature conditions, descriptions of the machinery and of the accommodation for the workpeople, which interest not only the engineer, but also the general reader, and it cannot be said that the author has encumbered his subject with unimportant or uninteresting details to any appreciable extent. The only exception we notice is that the tables of mean temperatures of such places as Venice, Alassio, and San Remo do not appear to have much bearing on the Simplon tunnel, under which heading they are tabulated. The text would have been handier had it been bound in two volumes.

From the same publisher we have the fourth volume of Brioschi's works, comprising mainly papers contributed to the Lincei Academy (1885-1896), the *Comptes rendus* (1858-1878), and miscellaneous journals, together with the preface and notes written for the Italian translation of Cayley's "Elliptic Functions." The papers for this volume have all been edited by Profs. Francesco Gerbaldi and Ernest Pascal, and the volume is uniform in style with its predecessors. In view of the rapid growth of mathematical literature, one cannot help wondering, however, if it is desirable to publish collected works in such an irreproachable style. This reflection is suggested partly by the fact that though one or two English transactions have recently appeared with larger pages than formerly, they do not contain a corresponding increase in the number of words per page, though there is a great increase in their *weight*. And it should be the object of the purchaser to obtain Brioschi's works, not merely to buy good paper and printing.

The series of Manuli Hoepli, published in the form of pocket-books, numbered 900 volumes in April last. Among the latest ones dealing with technical applications of science we have before us two books on gas engines, both written by authors living in Venice,

and containing respectively 160 and 162 woodcuts. The objects of the books, as stated in the prefaces, are nearly identical. Both authors point out that while other countries have advanced greatly in the study and construction of gas engines, the subject has received little attention in Italy. Curiously enough, Signor Calzavara, who is a gas engineer, says less about the question of gas than Signor Laurenti. The latter's book is divided into three parts, the first dealing with the combustibles (illuminating gas and heating gas, or "gas povero," as it is called in Italy), the second with gas generators, and the third with the gas engines themselves. On the other hand, Signor Calzavara only devotes a single chapter to the gas question. This chapter is, however, a long one, and it must be remembered that he has written several previous books on gas and gas motors.

Other differences may be noted. Thus Signor Calzavara gives a really full bibliography, while Signor Laurenti's book contains more numerical data in the form of tables. Signor Laurenti goes into detail regarding cams; the other author only just refers to distributors without discussing the cam. Signor Calzavara considers that a "poor gas" engine, with its own generator, cannot be used efficiently for installations of less than 25 horse-power; Signor Laurenti fixes the limit at 15 horse-power. These are the differences one would expect to find in two books written on the same subject by different authors, and they show that anyone interested in the subject would derive undoubted advantages from having both books for reference.

G. H. B.

#### THE ATOMIC THEORY OF ELECTRICITY.

*The Electron Theory; a Popular Introduction to the New Theory of Electricity and Magnetism.* By E. E. Fournier d'Albe. Pp. xxiii+311. (London: Longmans, Green and Co., 1906.) Price 5s. net.

A GLANCE at the table of contents of this book is sufficient to show that it fills an acute want at the present time. It attempts the consistent application of the all-embracing electron theory in an elementary manner to the whole range of electromagnetic phenomena. In making this attempt, the author is to be congratulated both on the choice of his subject and the skill and originality he has displayed in accomplishing it. It is a relief to find that the treatment, though popular, is to the point, and little or nothing is said of those vague and vast speculations as to the ultimate constitution of matter which have unfortunately become identified with the words "the electronic theory."

Few possess the necessary qualifications for a task which covers such a wide range of subjects, and, so far as we know, this is the first time it has been seriously attempted. The book is therefore unique, and should prove of value to the student, the teacher, and the investigator. Although, no doubt, it would be possible to go through the work pointing out where a fuller treatment of the subject-matter would have been advantageous, this would hardly be fair in the present state of the science. We have rather to be grateful that a trustworthy guide

to the theory in its existing state has pointed the way to its wide application in a great many cases. As the author repeatedly points out, the logical consequences of the electronic theory are still very far from being worked out in many of the subjects dealt with, and this task offers a fine field of investigation, which may ultimately lead to new results of the highest practical importance.

Probably nowhere is this more true than in the field of electrochemistry, of which, however, the treatment is somewhat superficial and unsatisfying. Another topic, which fares even worse, and yet is one of which much might have been, and ultimately will be, made, is the optical activity of carbon compounds. What little is said is so misleading, for example the last sentence of chapter xii., that it should be either omitted altogether or considerably amplified. In the main, however, the treatment is refreshingly clear and interesting.

Of course, it is to the explanation of that class of phenomena known as electromagnetic that the electron theory offers the greatest simplification. Consider a phenomenon such as "the spark on break due to the extra E.M.F. of self-induction," which is nothing but the electrical analogy of the water-hammer in a pipe when a cock is suddenly closed and the water stream stopped. For water read electrons, and for pipe read conductor, and even a beginner gets a clear mental picture of the phenomena. That all magnetic and electric phenomena are to be explained by definite motions and properties of the individual electron is a simplification that may be expected to ameliorate the lot of the future student considerably. The electron theory provides for electricity that clear mental image of the processes involved, without which physical theories stagnate and become metaphysical. Nevertheless, the faculty of being able to think in more than one system is not easily acquired, and it is doubtful, for example in magnetism, if anyone trained on the present systems will ever really abandon them.

In addition to the topics already alluded to, chapters are devoted to the electronic treatment of thermoelectricity, the Hall and allied effects, optical phenomena, the Zeeman effect, radiation, voltaic electricity, radio-activity, and the electric discharge. One chapter is devoted to a speculative effort, bold and imaginative, but logical, well considered, and unexceptionable, on the similarity of the infinitely great phenomena of the cosmos with the infinitely small of the electronic universe. Finally, a new system of electrical quantities is advocated, in which electricity, represented by *E*, ranks as a fundamental quantity with length, mass, and time. The author uses throughout the expressions "company of electrons," "army of electrons," to represent respectively the E.S. unit (2930 million) and the coulomb (8.79 trillions), and thus once for all reduces electric quantities to a definite number of electrons.

Different readers will no doubt derive most benefit from different chapters according to their individual knowledge of the subjects referred to, but the book

may be recommended to all interested in the progress of physical science. Dr. G. Johnstone Stoney, whose portrait appears as a frontispiece, contributes a preface to the work.

F. S.

#### OUR BOOK SHELF.

*Manual of the New Zealand Flora.* By T. F. Cheeseman. Pp. xxxvi+1199. Published under the authority of the New Zealand Government. (Wellington: J. Mackay, 1906.)

THE number of botanists who have contributed towards a knowledge of the New Zealand flora during the last forty years is remarkable, especially when it is recognised that their labours followed on discoveries made by earlier explorers and collectors of eminent repute. Banks and Solander, Colenso, Sinclair, and Hooker are a few of the early botanists whose work was collated in the "Handbook of the New Zealand Flora," compiled by Sir Joseph Hooker and published in 1864. Since that date, besides Colenso, Thomas Kirk stands out prominently as an energetic collector and author; he collected not only throughout both the main islands, but also visited several of the adjacent groups. Owing to his extensive acquaintance with the subject, in 1894 he was commissioned by the Government to prepare a flora of New Zealand, but the work was only half completed at the time of his death three years later. The task was subsequently entrusted in 1901 to Mr. Cheeseman, who has contributed numerous papers on new species, on the floras of Three Kings and Kermadec Islands, and on special methods of fertilisation in various genera. The wisdom of the choice is seen in the exhaustive and careful compilation now published.

The arrangement follows the plan of Hooker's earlier work, and to students of British botany acquainted with Bentham's "British Flora" this manual presents a familiar disposition.

Turning to the subject-matter, as the result of the last forty years' work, the computation of ferns and flowering plants has risen from about one thousand to nearly sixteen hundred species—exclusive of those naturalised—spread over 382 genera. With regard to orders the predominance of Compositæ is natural, but the flora is unusually rich in ferns and species of Scrophulariaceæ, and poor in species of Leguminosæ. The number of species in some of the genera is very large, amounting to forty-three in *Celmisia*, of which all are endemic with one exception; *Veronica* shows eighty-four species, of which, in contrast to our conception of the genus, seventy-one form shrubs or small trees. The flora contains many curious plants and unique associations that have been graphically described by Dr. L. Cockayne, but from a systematic point of view the most extraordinary fact is found in the enormous proportion of endemic species, amounting to nearly three-quarters of the total.

In working through a flora of such vast dimensions and containing so many exclusive species it will be comprehended that Mr. Cheeseman has accomplished a task of no small magnitude, and from the critical notes accompanying the technical diagnoses an idea is obtained of the wide knowledge and judicious discrimination that he has brought to bear upon it. The author and the New Zealand Government are both to be congratulated on the successful completion of the work.

Evidence of incorporation of the latest discoveries is found in the new genus *Townsonia* and various new species. The author has provided in the appendices a